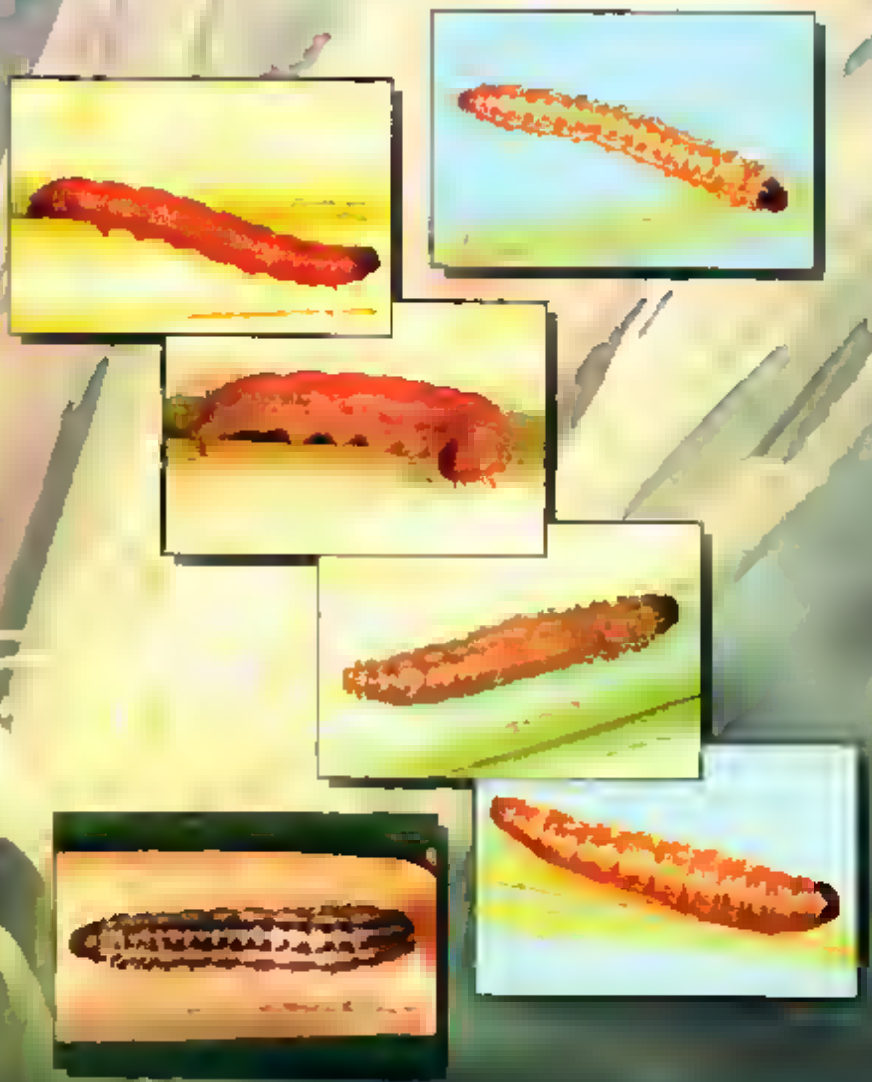
# Field Guide to the Stemborer Larvae of Maize, Sorghum and Sugarcane in Eastern and Southern Africa

*W. A. Overholt, K. V. N. Maes and F. R. Goebel*



# Field Guide to the Stemborer Larvae of Maize, Sorghum and Sugarcane in Eastern and Southern Africa

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*Chilo sacchariphagus*, F. R. Goebel
Identification key and damage section: K. V. N. Maes
*Chilo orichalcociliellus* adult: R. Copeland
*Chilo sacchariphagus* larva F. R. Goebel
*Sesamia calamistis* adult: A. Polaszek
*Sesamia calamistis* feeding in maize stem: H. Willson
*Chilo sacchariphagus* adult: F. R. Goebel
All other pictures, R. Copeland

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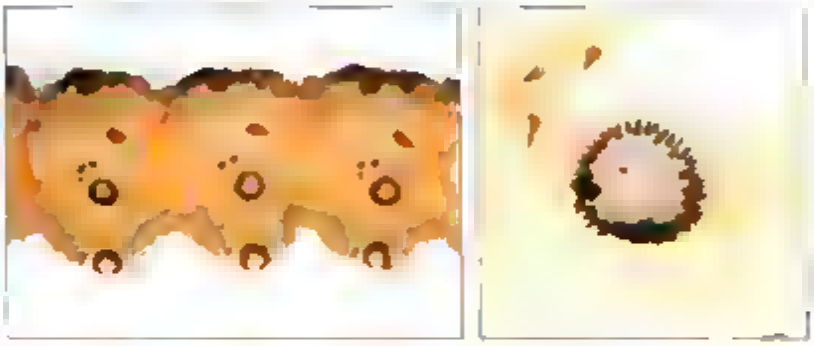
# Introduction

Lepidopteran stemborers are generally considered to be the most important group of insect pests that attack maize, sorghum and sugarcane in many areas of the world. In eastern and southern Africa, there are several important species. Correct identification of the stemborers occurring in an area is the first step towards developing an appropriate pest management strategy.

The objective of this publication is to provide agricultural scientists and extension workers with a simple, user-friendly taxonomic key to allow the rapid identification of larvae of the major stemborer species found in maize, sorghum and sugarcane in eastern and southern Africa. Fact sheets which summarise information on the geographic distribution, biology, host plant records, and economic importance of the stemborers are also included. Additionally, brief sections on collecting, rearing and preservation of stemborers are provided to facilitate sampling and identification.

# Key to the larvae of common stemborers in eastern and southern Africa: *Busseola fusca*, *Sesamia calamistis*, *S. cretica*, *Chilo partellus*, *C. orichalcociliellus*, *C. sacchariphagus* and *Eldana saccharina*



Crochets on ventral prolegs in a circular pattern

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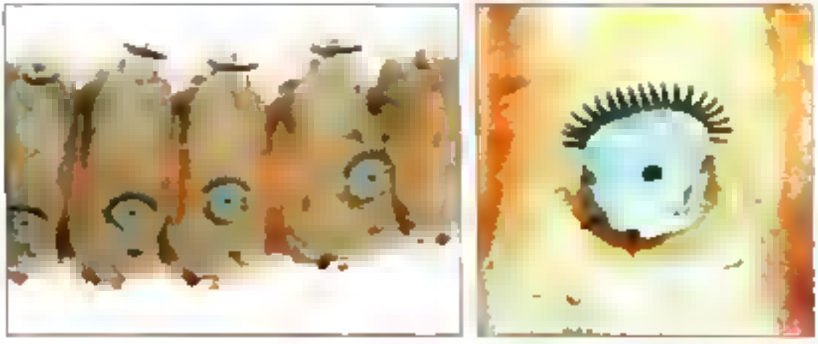

Crochets on ventral prolegs arranged in a linear pattern

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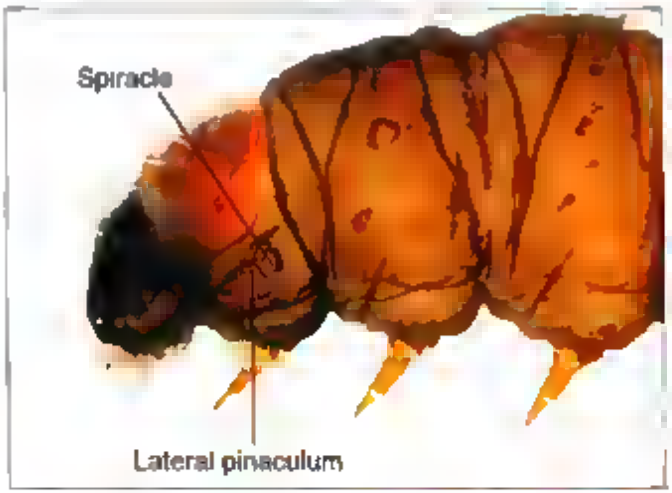
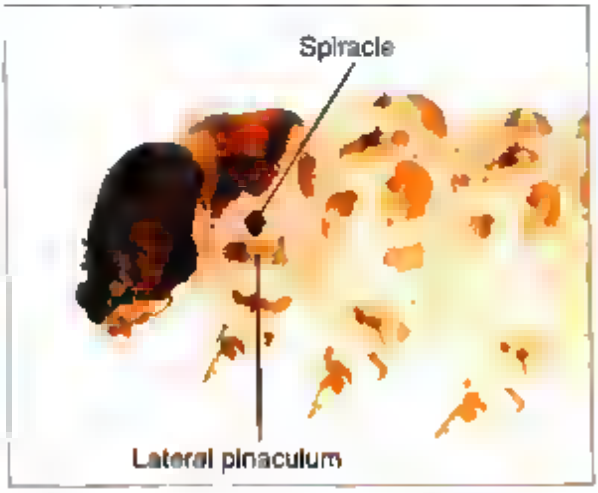



Lateral pinaculum on prothorax anterior to spiracle

↓

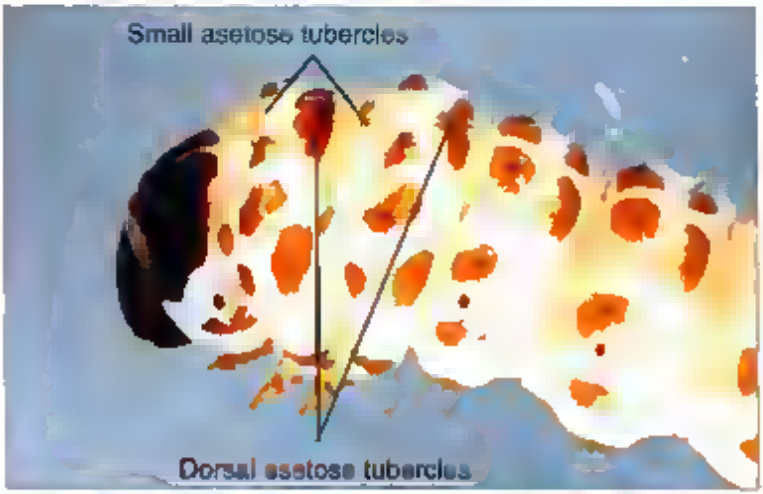
***Eldana saccharina***




Lateral pinaculum on prothorax ventral to spiracle

↓

*go to page 5*




On mesothorax and usually metathorax an additional small asetose tubercle, anterior to the large dorsal asetose tubercle

↓

***Chilo orichalcociliellus***

No asetose tubercle on mesothorax and metathorax anterior to the large dorsal asetose tubercle

↓

*go to page 6*

Lateral asetose tubercles on the first to the seventh abdominal segment

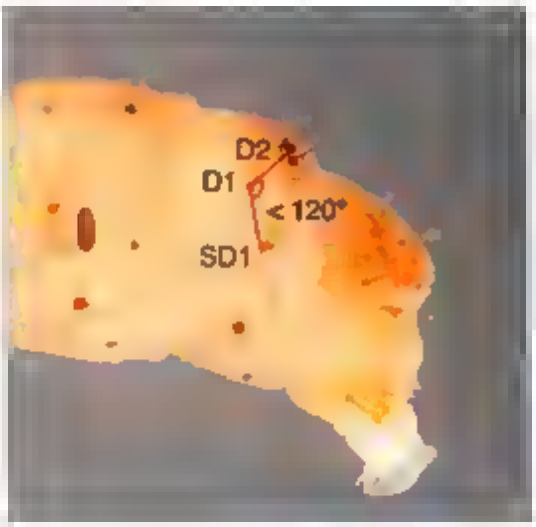
↓

***Chilo partellus***

Lateral asetose tubercles on abdominal segment absent

↓

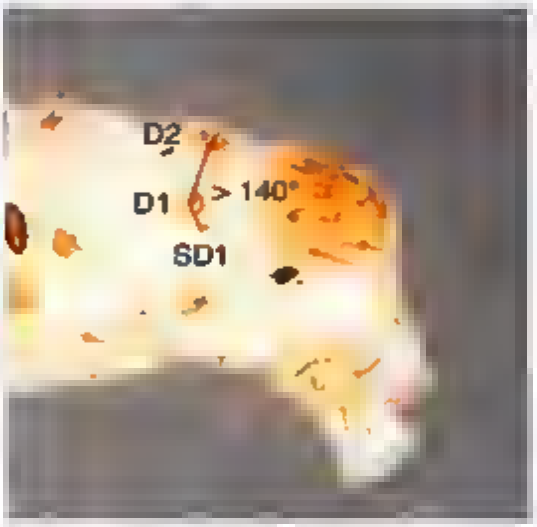
***Chilo saccharíphagus***




Angle between setae D2, D1 and SD1 usually less than 120°

↓

***Busseola fusca* or *Sesamia cretica***




Angle between setae D2, D1 and SD1 usually more than 140°

↓

***Sesamia calamistis***

If you find a stemborer larva that does not fit this key, you may mail the larva to:

Biosystematics Unit
International Centre of Insect Physiology and Ecology (ICIPE)
P.O. Box 30772, Nyayo Stadium, Nairobi, Kenya

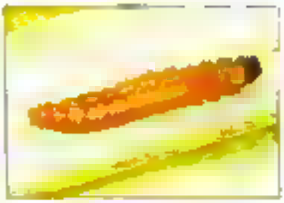
# Fact sheets

## *Chilo partellus* (Swinhoe)

**Common name:** Spotted stemborer

**Family:** Crambidae

Eggs



Larva

Adult

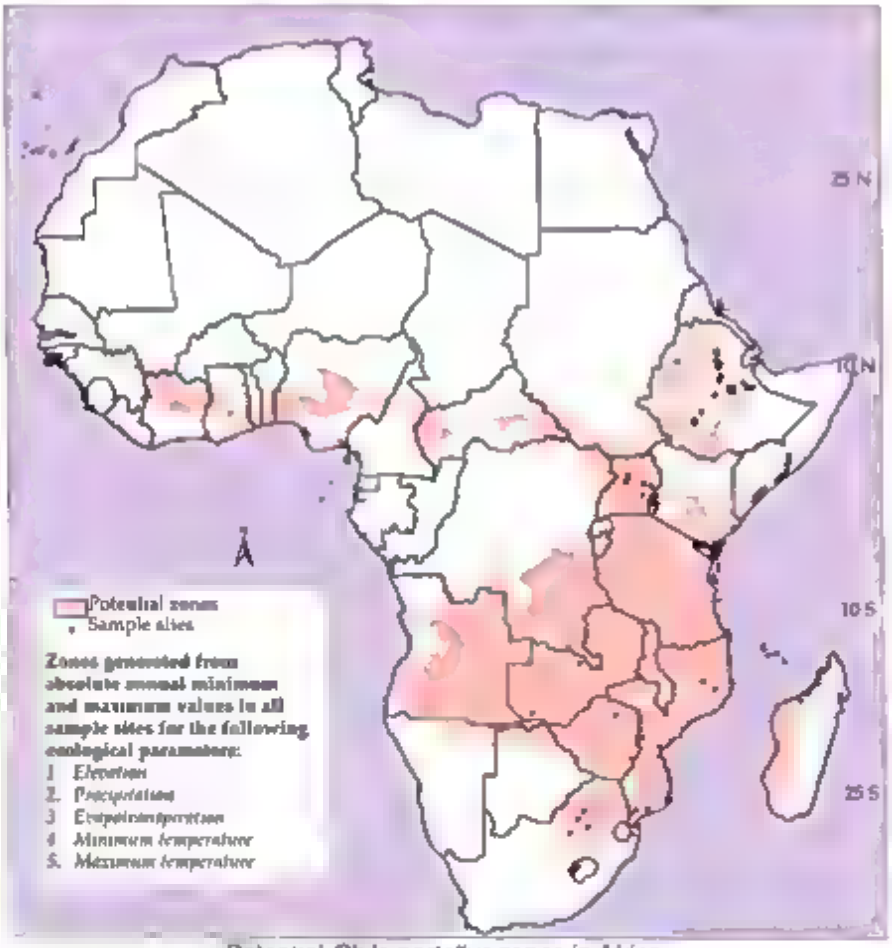
### Host records

Maize, sorghum, rice, sugarcane, *Eleusine coracana*, *Hyparrhenia rufa*, *Panicum maximum*, *Pennisetum purpureum*, *Rottboellia compressa*, *Sorghum verticilliflorum*, *Vossia cuspidata* (Bleszynski, 1970), *Cenchrus ciliaris*, *Coix lacryma-jobi*, *Dactyloctenium bogdanii*, *Echinochloa haploclada*, *Echinochloa pyramidalis*, *Hyparrhenia filipendula*, *Hyparrhenia pilgeriana*, *Hyparrhenia rufa*, *Panicum deustum*, *Panicum maximum*, *Pennisetum purpureum*, *Pennisetum trachyphyllum*, *Phragmites* sp., *Rottboellia cochinchinensis*, *Setaria incrassata*, *Sorghum arundinaceum*, *Sorghum vesicolor*, *Sorghum vulgare* var. *sudanense*, *Sporobolus marginatus* (Khan et al., 1997).

### Geographic records

*Chilo partellus* is native to Asia where it is considered to be a pest of maize and sorghum. It was first reported in Africa in 1930 in Malawi, and has since spread to most countries in eastern and southern Africa, including Ethiopia, Kenya, Malawi, Mozambique, Somalia, South Africa, Sudan, Tanzania, Uganda (CAB, 1977), Botswana, Swaziland, Zimbabwe (Sithole, 1990), Comoro Islands, Madagascar (Bleszynski, 1970, Delobel, 1975) and Lesotho (Ebenebe et al., 1998). Additionally, recent samplings conducted by ICIPE and / or national programmes have found *C. partellus* in Eritrea, Zambia, Zanzibar and Somalia (unpublished).

Using geographic information system (GIS) software, Overholt et al. (2000) have predicted its eventual distribution, which includes several countries




Potential *Chilo partellus* zones in Africa

*(see page 10 for notes on species distribution maps)*

in West Africa. However, as far as is currently known, *C. partellus* has not yet invaded West Africa.

## Economic importance

*Chilo partellus* is considered to be the most important stemborer in most low to medium elevation areas of eastern and southern Africa. Yield losses in maize of 18% were attributed to *C. partellus* and *C. orichalcociliellus* in the southern coastal area of Kenya (Warui and Kuria, 1983), and 50% in southern Mozambique (Sithole, 1990). Losses of 2–88% due to *C. partellus* have been reported in sorghum (Seshu Reddy, 1988). Recent evidence

suggests that *C. partellus* is increasingly becoming a pest in higher elevation areas as well (Kfir, 1997).

## Biology

Adults emerge from pupae in the late afternoon and early evening and are active at night. During the day they rest on plants or plant debris. Females mate soon after emergence and oviposit on two to three subsequent nights, in batches of 10–80 overlapping eggs, on the upper and undersides of leaves, mainly near the midribs. Some eggs are also laid on the stem. Adults live for about 2–5 days and do not normally disperse far from emergence sites. Eggs hatch in the early morning (06:00–08:00 h), 4–8 days after being laid, and young larvae ascend plants to enter the leaf whorls, where they start to feed. Older larvae tunnel into stem tissue, and after feeding for 2–3 weeks, pupate in the stems for 5–12 days. Under favourable conditions, the life cycle is completed in 25–50 days, and five or more successive generations may develop during a single maize growing season. In cold and/or dry conditions, larvae may enter a resting stage (diapause) in stems, stubble and other crop residues, where they spend up to 6 months before pupating when favourable conditions return during the next growing season. However, part of the stemborer population may remain active in wild grasses during dry seasons.

*Species distribution maps*

The species distribution maps (except that for *Chilo sacchariphagus*) were generated using geographic information system (GIS) software. Geo-positioned data on species occurrence, from our own sampling data and from the literature, were used to characterise the environment where each borer species was found. GIS was then used to interpolate beyond the sampling locations to locate all areas which shared similar environments. The potential distributions of the native stemborers, *Busseola fusca*, *Sesamia calamistis* and *C. orichalcociliellus*, are only shown for eastern and southern Africa. This is because there is evidence that the environments where these species are found in West Africa, are not the same as those they inhabit in the eastern and southern parts of the continent. Thus, extrapolating beyond our data set would have led to erroneous predictions. No map was included for *Eldana saccharina* due to a paucity of geo-positioned data on this species. For the invasive species *Chilo partellus*, we included West Africa in the prediction, even though there are no reliable records of *C. partellus* occurring in that part of the continent. However, as an invasive species which is still spreading in Africa, we felt that it would be useful to indicate those areas of West Africa that may be favourable to the eventual establishment of *C. partellus*. The map for *C. sacchariphagus* indicates the only location (Malambisse Sugar Estate) that this species has been found on mainland Africa.

## *Chilo orichalcociliellus* (Strand)

**Common name:** Coastal stemborer

**Family:** Crambidae

Eggs

Larva

Adult

### Host records

Maize, sorghum, *Eleusine coracana*, sugarcane, *Panicum maximum*, *Pennisetum purpureum*, *Sorghum arundinaceum*. Comparative studies conducted by Ofomata et al. (2000) indicated that more *C. orichalcociliellus* than *C. partellus* survived in *Panicum maximum* and *Pennisetum purpureum*.

### Geographic records

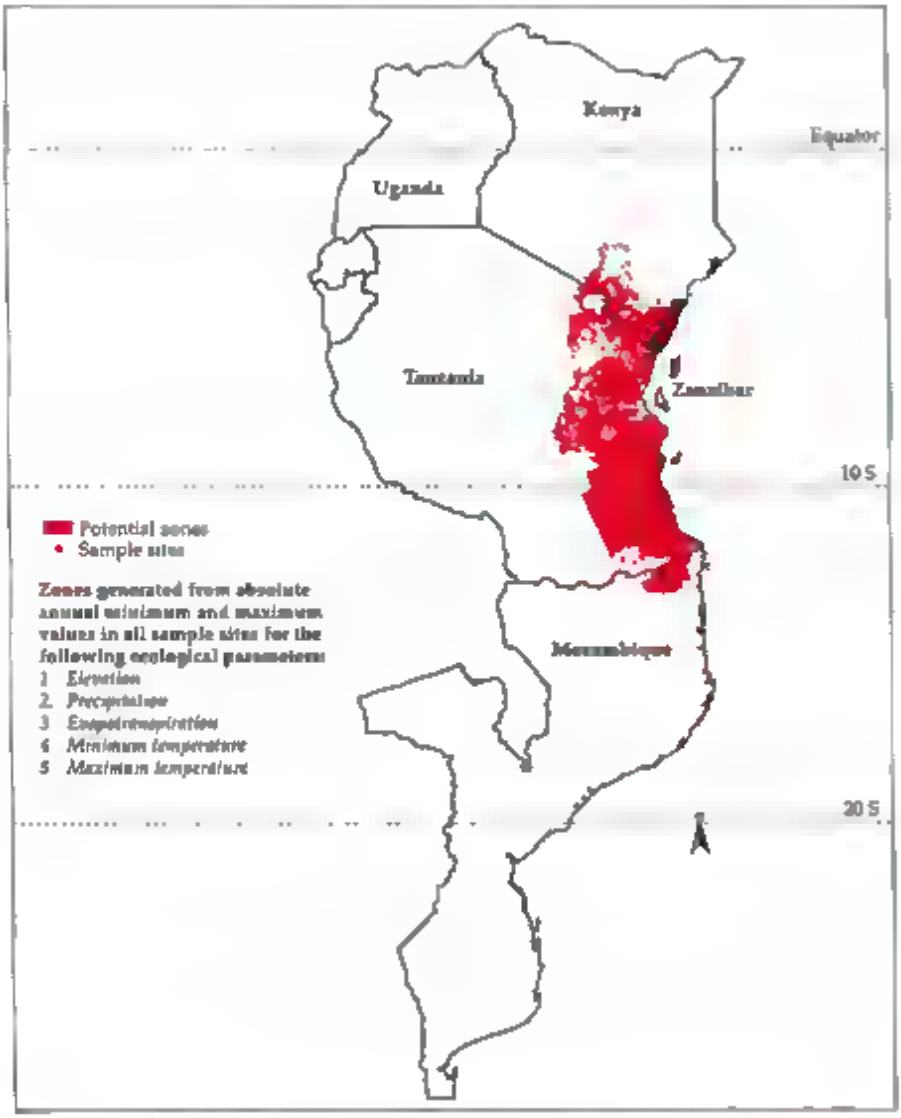
Kenya, Tanzania, Malawi, Madagascar, South Africa, Zimbabwe, and the Democratic Republic of Congo (Bleszynski, 1970). In Kenya, the distribution of *C. orichalcociliellus* is limited to the lowland coastal area.

### Economic Importance

Formerly considered to be an important pest of maize and sorghum in southern coastal Kenya, there is evidence that this species has been largely displaced by *C. partellus* in this area (Ofomata et al., 2000).

### Biology

Similar to that of *C. partellus*. Recently conducted comparative studies have shown that *C. partellus* has certain competitive advantages over *C. orichalcociliellus*. Population growth of *C. partellus* was higher than that of *C. orichalcociliellus* on maize, sorghum and some wild hosts (Mbapila, 1997; Ofomata et al., 1999a, 2000). Additionally, diapause terminated faster in *C. partellus* than in *C. orichalcociliellus* (Ofomata et al., 1999b). These differences may partly explain the displacement of *C. orichalcociliellus* by *C. partellus* in coastal Kenya.

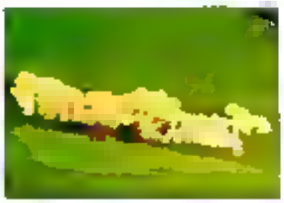



Potential *Chilo orichalcociliellus* zones in eastern Africa

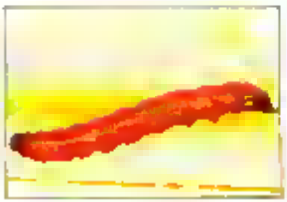
## *Busseola fusca* Fuller

**Common name:** African maize stemborer

**Family:** Noctuidae



Eggs



Larva

Adult

### Host records

Maize, sorghum, pearl millet, finger millet, sugarcane, *Hyparrhenia rufa*, *Panicum maximum*, *Pennisetum purpureum*, *Phragmites* sp., *Rottboellia exaltata*, *Sorghum arundinaceum*, *Sorghum verticilliflorum* (Harris and Nwanze, 1992), *Echinochloa pyramidalis*, *Hyparrhenia cymbaria*, *Hyparrhenia pilgeriana*, *Hyparrhenia rufa*, *Panicum dcustum*, *Panicum maximum*, *Pennisetum purpureum*, *Pennisetum trachyphyllum*, *Rottboellia cochinchinensis*, *Setaria incrassata*, *Setaria sphacelata*, *Sorghum arundinaceum*, *Sorghum vesicolor*, *Sorghum vulgare* var. *sudanense*, *Sporobolus marginatus*, *Sporobolus pyramidalis*, *Tripsacum laxum*, *Typha domingensis* (Khan et al., 1997).

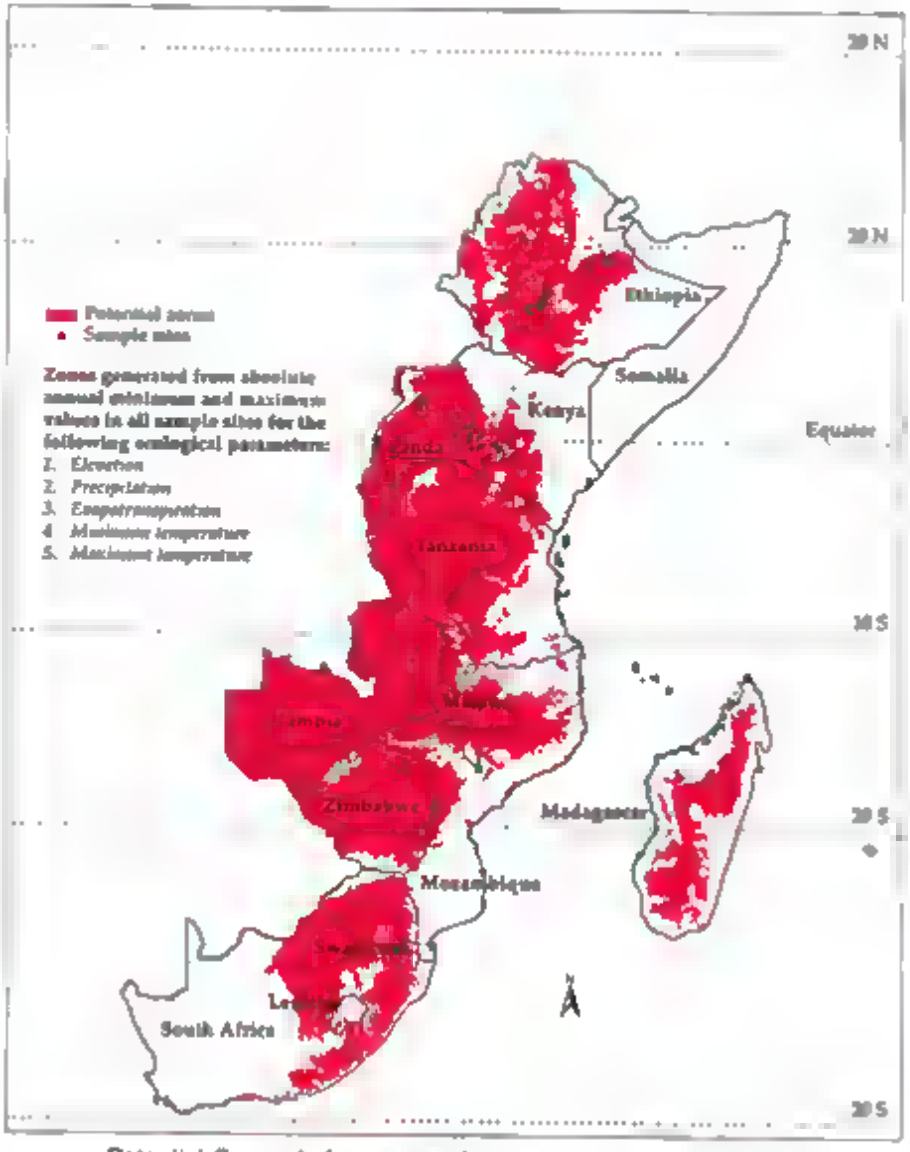
### Geographic records

*Busseola fusca* is distributed widely throughout sub-Saharan Africa. Populations in eastern and southern Africa appear to be adapted to different environments from those in West Africa. In the eastern and southern parts of the continent, *B. fusca* is restricted to mid- and high-elevation areas (>600 m), whereas in West Africa, the same species is found at all elevations, but is most abundant in the drier savanna zone. Country records include Angola, Benin, Botswana, Burkina Faso, Cameroon, Ethiopia, Ghana, Guinea, Côte d'Ivoire, Kenya, Lesotho, Malawi, Mali, Mozambique, Nigeria, Rwanda, Sierra Leone, Somalia, South Africa, Swaziland, Tanzania, Uganda, Zaire, Zambia and Zimbabwe (Harris and Nwanze, 1992).

### Economic importance

In the mid- and high-elevation areas of eastern and southern Africa, *B. fusca* is often the most serious stemborer of maize. Yield losses have been

estimated to be about 12% for every 10% of plants infested (Harris and Nwanze, 1992). In Burundi, *B fusca* occasionally caused yield losses of 30–50% (Muyango, 1987). In Zaire, losses of 8–9% in early-planted maize, and 22–25% in late-planted maize have been reported. In Cameroon, Cardwell et al. (1997) reported grain weight loss as 4.6 g per borer in lowland fields and 8.7 g per borer in highland fields.




Potential *Busseola fusca* zones in eastern and southern Africa

### Biology

The female lays several hundred eggs in batches of 30–50, inserted between the sheath and the stem. Incubation lasts about 1 week. After hatching, the larvae feed on the young blades of the leaf whorl and then, suspended from silk strands, spread to neighbouring plants. They penetrate the stems by boring through the whorl base. Generally, they destroy the growing point and tunnel downward. After passing through six to eight stages in 30–45 days, they chew an outlet for the adult and pupate in the tunnel. Pupation lasts 10–20 days. Up to four generations are produced per year. At the end of the rainy season, larvae of the last generation enter diapause in maize and sorghum stubble or in wild grasses. They pupate a few months later, just before the start of the following rainy season.

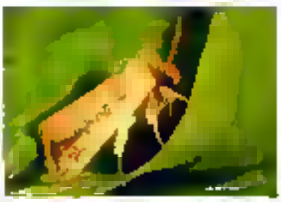
## *Sesamia calamistis* Hampson

**Common name:** Pink stemborer

**Family:** Noctuidae

Eggs

Larva



Adult

### Host records

Maize, sorghum, finger millet, rice, sugarcane (Nye, 1960), *Andropogon* sp., *Cenchrus ciliaris, Coix lacryma-jobi, Echinochloa haploclada, Echinochloa pyramidalis, Hyparrhenia filipendula, Hyparrhenia rufa, Panicum maximum, Pennisetum purpureum, Phragmites* sp , *Setaria sphacelata, Sorghum arundinaceum, Sorghum vesicolor, Sorghum vulgare* var *sudanense, Tripsacum laxum, Vossia* spp., *Cyperus distans, Cyperus immensis, Cyperus papyrus, Typha domingensis* (Khan et al., 1997).

### Geographic records

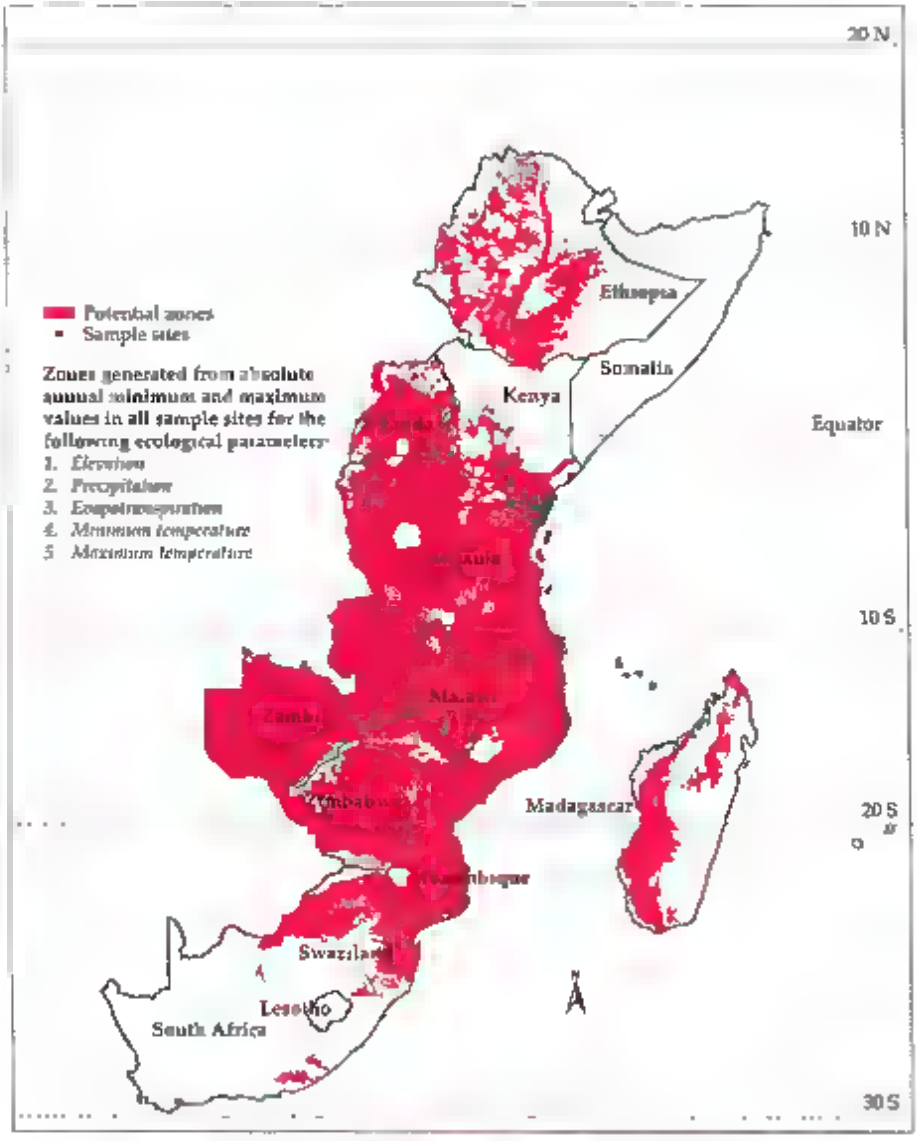
*Sesamia calamistis* occurs throughout most of tropical Africa. Country records include South Africa, Zimbabwe, Malawi, Uganda, Tanzania, Kenya, Zanzibar, Madagascar, Mauritius, Reunion, Angola, Nigeria, Côte d'Ivoire, Cameroon, Senegal, Gambia, Ghana (Tams and Bowden, 1953), Mozambique (Cugala et al., 1999), Ethiopia (Gebre-Amlak, 1985), Eritrea and Zambia (unpublished).

### Economic importance

In eastern and southern Africa, *S. calamistis* is of only moderate importance. Although it has a very wide distribution, densities are typically low. In contrast, *S. calamistis* is considered to be a very damaging borer in West Africa (Bosque-Perez and Schulthess, 1998).

### Biology

In 3–5 days, the female lays up to 350 eggs, deposited in batches of 10–40. The eggs are arranged in two to four contiguous rows and inserted




Potential *Sesamia calamistis* zones in eastern and southern Africa

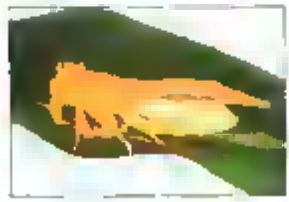
between the lower leaf sheaths and stems. Several hours after hatching, the larvae leave the oviposition site to penetrate the stems either directly or after feeding on the leaf sheath. During the larval stage, which lasts 30–60 days, depending on climatic conditions, and usually involves five to six moults, larvae may successively attack a number of young stems. Only one immature larva is observed per young stem or tiller. Pupation generally takes place in the stem, rarely between the sheath and stem. The pupal period lasts 10–12 days at 25 °C. Under tropical conditions five to six generations are completed in a year. *Sesamia calamistis* breeds throughout the year without a diapause.

*Sesamia calamistis* larva feeding in maize stem

## *Sesamia cretica* Lederer

**Common names:** Durra stemborer, pink stemborer

**Family:** Noctuidae



Adult

### Host records

Sorghum, maize, sugarcane, oats, wheat, rice.

### Geographic records

Morocco, Egypt, Sudan, Somalia (Tams and Bowden, 1953) and extreme northern Kenya (Nye, 1960). Outside of Africa it occurs in the south and west Mediterranean, Yemen, Crête, India, Sri Lanka and Thailand (Tams and Bowden, 1953).

### Economic importance

A major pest of sorghum, and to a lesser extent maize. Also considered to be an important pest of sugarcane in Sudan (El Amin, 1984).

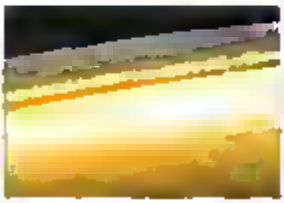
### Biology

Presumably similar to that of *S. calamistis*.

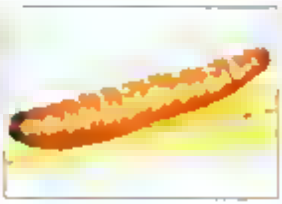
## *Eldana saccharina* (Walker)

**Common name:** African sugarcane stemborer

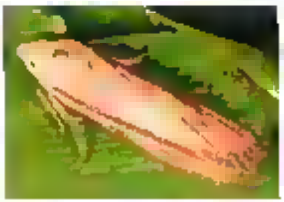
**Family:** Pyralidae



Eggs



Larva



Adult

### Host records

Sugarcane, maize, rice, sorghum, *Panicum maximum*, *Pennisetum purpureum*, *Phragmites* sp., *Rottboellia cochinchinensis*, *Sorghum arundinaceum*, *Sorghum vesicolor*, *Sorghum vulgare* var. *sudanense*, *Cyperus distans*, *Cyperus immensis*, *Cyperus maculatus* and *Cyperus papyrus* (Khan et al., 1997).

### Geographic records

Wide distribution in sub-Saharan Africa including Burundi, Chad, Ghana, Kenya, Mozambique, Nigeria, Rwanda, Sierra Leone, Somalia, South Africa, Tanzania, Uganda and Zaire (Maes, 1998).

### Economic importance

In southern Africa, *E. saccharina* is considered to be a serious pest of sugarcane (Atkinson, 1980). In eastern Africa, *E. saccharina* attacks maize, but usually towards the end of the growing season, and is generally not considered to be a major pest. In West Africa, *E. saccharina* is a pest of maize and sugarcane. Bosque-Perez and Mareck (1991) found that even though *E. saccharina* attacks maize plants late in the growing season, damage can be as high as 20%.

### Biology

Atkinson (1980) published a detailed account of the biology, distribution and natural hosts of this species in Natal, South Africa. Girling (1978) reported similar studies in Uganda, and Sampson and Kumar (1985) have studied this species in Ghana. Females lay batches of 50–100 eggs on dry

leaves at the bases of plants, which may partly explain the tendency of *E. saccharina* to infest mature crops. Eggs hatch after about 6 days and the young larvae feed externally on epidermal tissue before penetrating the stems. The length of larval development is variable and may take up to 2 months. Larvae pupate within the stems. Up to six generations may develop in a year and there is no larval diapause.

## *Chilo sacchariphagus* (Bojer)

**Common names:** Spotted sugarcane borer, spotted stemborer

**Family:** Crambidae

Eggs

Larva

Adult

### Host records

Sugarcane, rarely maize (Williams, 1983), wild *Saccharum* spp. (Kuniata, 1994), *Miscanthus* sp. (Cheng, 1994).

### Geographic records

*Chilo sacchariphagus* is southeast Asian in origin, occurring in India, Thailand, Taiwan, Vietnam, Mainland China, Japan (Okinawa), Philippines, Malaysia, Sri Lanka (Cheng, 1994), Papua New Guinea, Java, Indonesia and Bali (Kuniata, 1994). It is also present in the Indian Ocean islands of Madagascar, Mauritius and Réunion, it is thought to have been introduced into Mauritius and Réunion from Java in 1850 (Williams, 1983; Goebel, 1999). In 1999, it was confirmed attacking sugarcane on an estate at Mafambisse (34º 10'E; 19º 20'S), Mozambique (Way and Turner, 1999), although its presence on this estate had been recorded in unpublished reports as early as 1989 (van Rensburg et al., 1989).

### Economic importance

In its area of origin *C. sacchariphagus* is well controlled by numerous parasitoids (Cheng, 1994, Kuniata, 1994). In the Indian Ocean islands it is a major pest of sugarcane (Williams, 1983), and has been the target of an intensive biological control programme in Mauritius (Williams, 1983; Ganeshan and Rajabalee, 1997) and Réunion (Vercambre, 1993; Goebel, 1999) for many years. At Mafambisse Sugar Estate in Mozambique (6410 ha), annual losses due to this borer are currently estimated at between 14,000 and 35,000 tonnes of cane per ha (Turner, 1999). In Réunion, losses of 30 to 40 tonnes of cane have been measured in heavy infestations (Goebel, 1999).

## Biology

*Chilo sacchariphagus* adults mate at dusk on the night of their emergence (Williams, 1983). Females lay between 200 and 850 eggs in batches of 18–30 in 2 to 3 parallel rows next to the midrib of green leaf blades, generally on the upper surface, but sometimes also on the abaxial surface about halfway along the leaf blade (Williams, 1983; Cheng, 1994, Kuniata, 1994). First instars bore into the spindle, through the leaf midrib and leaf blades, and sometimes scarify the leaf surface. Larval peaks generally occur during early cane growth (from 3 to 7 months). All larval stages can be found in all the internodes from the bottom to the top of the stalk, depending on the period of attack and the time of survey (Goebel, 1999).

Larvae ready to pupate cut an exit hole in the stalk rind, and then pupate in the stem near the exit hole (Williams, 1983, Kuniata, 1994). They do not spin a silken cocoon before pupation. The insect is multivoltine, breeding throughout the year, with 3 to 4 generations per annum. In Réunion, life table studies show that *C. sacchariphagus* is more likely to develop large populations in the lowlands of the island, where temperature exceeds 20 °C nearly all year round (optimum temperature for development of *C. sacchariphagus* is 26 °C) (Goebel, 1999).

Known distribution of *Chilo sacchariphagus* in Mozambique

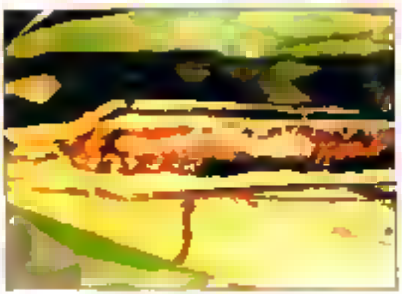
# Damage symptoms

Stemborers damage plants by feeding on the leaves, in the stems and on the cobs. Early instars of *Chilo* spp. and *Busseola fusca* typically migrate from the oviposition site to the whorl where they feed for the first two or three instars on young succulent leaf tissue. This type of feeding is characterised by 'pin holes' and 'window panes'. Pin holes are a linear series of small holes created when larvae chew horizontally through developing leaves in the whorl. The damage becomes quite evident as the leaves mature and expand out of the whorl. Window panes refer to early larval feeding in which the larvae do not completely chew through the leaf but leave a thin layer of transparent leaf epidermis.

Early instar feeding by *Sesamia* spp. and *Eldana saccharina* is not usually in the whorl. *Sesamia* spp. feed for a few days in the leaf sheath (between the leaf and the stem) and then tunnel into the stem. *Eldana saccharina* larvae migrate from the oviposition site and spread out on the leaves where they tunnel in leaf tissue near the midrib.

From about the third instar, *Chilo* spp., *Busseola fusca* and *Eldana saccharina* bore into the stem where they feed until pupation. Sometimes larvae bore directly into the stem from the whorl and may cause a kind of damage referred to as 'deadheart' where the growing point of the plant is killed. In sugarcane, *C. sacchariphagus* larval feeding in young plants can cause side shooting. The entrance holes chewed by larvae when entering the stem can often be seen, and in moist plants may be accompanied by frass flowing from the hole.

Prior to pupation, stemborer larvae chew an exit hole for the emergence of the moth. The hole is sometimes referred to as a 'window' because it is not chewed completely through the stem but leaves the transparent leaf epidermis. In reproductive stage maize, stemborers may be found feeding in the cobs and tassels.



# Sampling stemborers in maize or sorghum fields

Sampling of stemborers may be conducted for a variety or reasons:

- to estimate the density of borers in a field or area,
- to estimate the proportion of plants infested,
- to determine the species composition of the borers, or
- to determine the age distribution of the borers.

Often, information on more than one of these objectives is desired. It is important to determine which type of information is needed before starting to sample so thet the sampling methods are properly designed to provide the desired information.

Stemborers are typically sampled by examining whole plants. If information on the proportion of plants infested in a field or area is needed, then it may be possible to simply examine a number of plants for external signs of infestation, without disturbing the plants. However, if an estimate of density, or information on the species composition is needed, then destructive sampling is necessary. Destructive sampling involves removing the plant from the soil and carefully dissecting the plant to find all the borers. Stemborers may be found in all above-ground parts of the plant. However, eggs will be found mostly on the leaves and stems (Pyraloidea) or between the leaf sheaths and the stem (Noctuidae). Early instars tend to migrate to the plant whorl, and later instars are mostly found feeding internally in the stem. Pupae are also most commonly found in the stem. Adults are most often sampled with light or pheromone traps.

## Rearing stemborera for idantification

At times it may be necessary to rear field-collected stemborers to a later life stage to facilitate identification. Small first and second instars are difficult to identify, and some apecies can only be positively identified by examining the adults. The simplest way to rear field-collected material is to place the insect on the same diet from which it was collected in a clean container. The diet could be leaves, stems or cobs. If small larvae are collected from the whorl of maize plants, they should first be reared on whorl material, and then placed on maize atems once they become third instars. Any small glass or plastic container which is aerated by making holes in the lid, or replacing the lid with screen or loosely woven cloth, is adequate. The important thing is that the container is clean. The diet must be changed every couple of days to avoid the build up of microbial contaminants.

## Preservation of larvae

Stemborer larvae are collected live and brought to the laboratory in the stems in which they were collected Some larvae can be kept for rearing to adults. Others are killed and preserved for study Larvae should always be preservad in fluid. Stemborer larvae tend to turn black once killed. To prevent thus, the larvae are dropped live in water that has just come off the boil, and left there for a few minutes. They will stretch to their full length and retain their natural colour. Afterwards they are transferred to 70–80% ethyl alcohol to which a little glycerine is added.

If some larvae from a collection are reared to the adult stage, correct cross-references must be kept. When doubts exist in the identification of larvae, the adults may provide the necessary characters for species identification.

## Shipment of specimens for identification

It may be necessary to ship larvae or adult moths for identification. If so, always include the full data with the specimens: country, province, locality, date of collection, collector and host plant.

Larvae are shipped in small vials containing some alcohol. Labels included in the vial are written with Chinese ink or pencil.

Adult moths are usually pinned or preserved in small envelopes. This material is very fragile and requires precautions to prevent damage when sending through the mail. Moths in envelopes can be sent in a small box between some layers of cotton. Pinned moths are placed in a small box and every moth is prevented from moving by adding additional pins. Detached abdomens are kept in gelatine capsules attached on the pin of the specimen. The small box with specimens is placed in a larger box with polystyrene chips to prevent shocks during transport. For customs purposes, attach a label:

*Dried Insects*
*For Scientific Purposes Only*
*No Commercial Value.*

Larvae and moths can be mailed for identification to:

Biosystematics Unit
International Centre of Insect Physiology and Ecology (ICIPE)
P. O. Box 30772, Nyayo Stadium
Nairobi, Kenya

Tel: +254 (2) 861680–4
Fax: +254 (2) 860110/803360
E-mail: biosys@icipe.org

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